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Numerical and Experimental Developments in Nonlinear Structures

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Our work aims to exploit structural nonlinearity in engineering, with a particular focus on aerospace applications, to develop well-behaved nonlinear structures [1]. To achieve this, we are developing novel numerical and experimental methods. Generalised path-following methods are used to numerically investigate the properties of nonlinear structures [2], and have been applied to thin-walled shells, slender frames, and beam structures. In addition to improved numerical methods, experimental validation of nonlinear structures is critical in ensuring their use in engineering applications, especially in conservative industries such as commercial aviation. Existing experimental techniques are unable to fully characterise the nonlinear response of even simple nonlinear structures, as they cannot measure structures with force-displacement responses that include limit points and snapping behaviour. An experimental method has been developed to extend our ability to measure the structural response of nonlinear structures [3]. In this presentation we will present our recent developments in both numerical and experimental work on nonlinear structures.

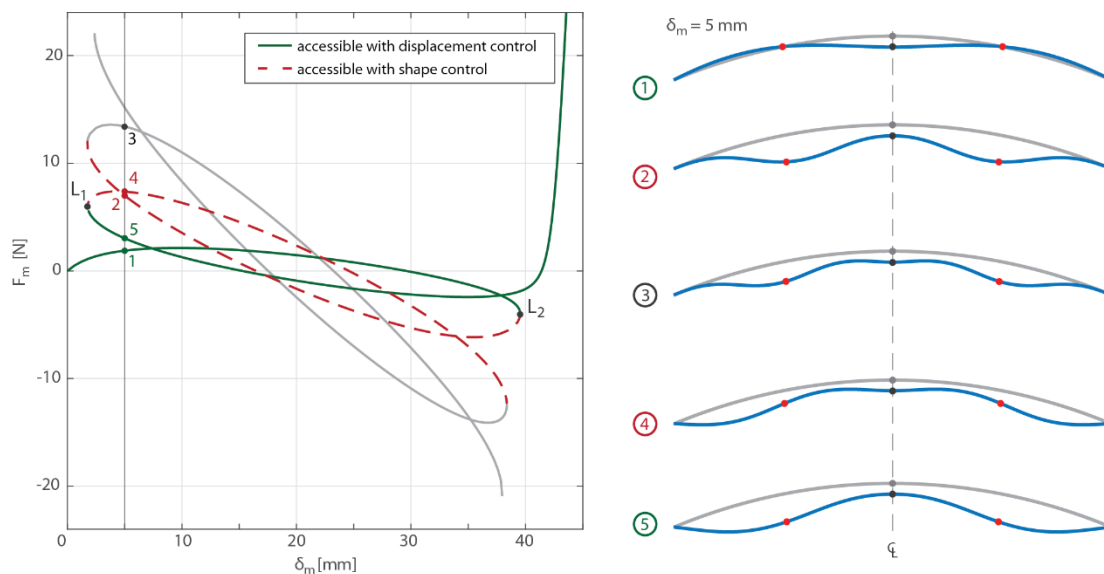


Figure 1: force-displacement response of shallow arch, with deformed shapes. Existing experimental techniques are unable to measure beyond the displacement limit points (L_1 , L_2), but a new experimental method is able to capture more of the structural response.

[1] G. Arena, R.M.J. Groh, A. Brinkmeyer, R. Theunissen, P.M. Weaver and A. Pirrera (2017), *Adaptive compliant structures for flow regulation*, Proceedings of Royal Society A, 473:20170334

[2] R.M. Groh, D. Avitabile, A. Pirrera (2017), *Generalised path-following for well-behaved nonlinear structures*, Computer Methods in Applied Mechanics and Engineering, 331:394-426

[3] R.M. Neville, R.M.J. Groh, A. Pirrera, M. Schenk (2018), *Shape Control for Experimental Continuation*, under review.